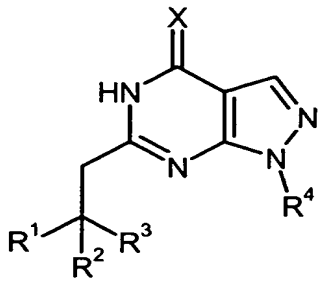
Claims

1. A compound of the formula



(I),

in which

R^1 is C_1-C_6-alkyl, trifluoromethyl, hydroxy, C_1-C_6-alkoxy, -C(=O)OR^5 or -C(=O)NR^6R^7, where C_1-C_6-Alkyl is optionally substituted by 1 to 3 radicals independently of one another selected from the group of hydroxy, C_1-C_6-alkoxy, halogen, trifluoromethyl, trifluoromethoxy, -C(=O)OR^5 or -C(=O)NR^6R^7, and

R^5 is C_1-C_6-alkyl,

R^6 and R^7 are independently of one another hydrogen, C_6-C_{10}-aryl, C_1-C_6-alkyl, or
together with the nitrogen atom to which they are bonded form a 4- to 10-membered heterocyclyl,

R^2 is hydrogen, C_1-C_6-alkyl, trifluoromethyl, C_1-C_6-alkoxy,

or

R^1 and R^2 together with the carbon atom to which they are bonded form C_3-C_8-cycloalkyl, C_3-C_8-cycloalkenyl or 4- to 10-membered heterocyclyl, which are optionally substituted by up to 2

substituents from the group of C_1-C_6-alkyl, C_1-C_6-alkoxy, hydroxy, oxo, -C(=O)OR^8, and

R^8 is C_1-C_6-alkyl or benzyl,

R^3 is hydrogen or C_1-C_6-alkyl,

R^4 is pentan-3-yl, C_3-C_6-cycloalkyl,

X is oxygen or sulfur,

and the salts, solvates and/or solvates of the salts thereof.

2. A compound as claimed in claim 1, wherein

R^1 is C_1-C_6-alkyl, hydroxy, C_1-C_6-alkoxy, -C(=O)OR^5 or -C(=O)NR^6R^7, where C_1-C_6-alkyl is optionally substituted by hydroxy, C_1-C_6-alkoxy, -C(=O)OR^5 or -C(=O)NR^6R^7, and

R^5 is C_1-C_6-alkyl,

R^6 and R^7 are independently of one another hydrogen, C_6-C_{10}-aryl, C_1-C_6-alkyl, or

together with the nitrogen atom to which they are bonded form a 4- to 10-membered heterocyclyl,

R^2 is hydrogen, C_1-C_6-alkyl, C_1-C_6-alkoxy,

or

R^1 and R^2 together with the carbon atom to which they are bonded form C_3-C_8-cycloalkyl, C_3-C_8-cycloalkenyl or 4- to 10-membered heterocyclyl, which are optionally substituted by up to 2 substituents from the group of C_1-C_6-alkyl, C_1-C_6-alkoxy, hydroxy, oxo, -C(=O)OR^8, and

R^8 is C_1-C_6-alkyl or benzyl,

R^3 is hydrogen or C_1-C_6-alkyl,

R^4 is pentan-3-yl, C_4-C_6-cycloalkyl,

X is oxygen or sulfur,

and the salts, solvates and/or solvates of the salts thereof.

3. A compound as claimed in claims 1 and 2, where

R^1 is C_1-C_4-alkyl, hydroxy, C_1-C_4-alkoxy, -C(=O)OR^5 or -C(=O)NR^6R^7, where C_1-C_4-alkyl is optionally substituted by hydroxy, trifluoromethyl, C_1-C_4-alkoxy, -C(=O)OR^5 or -C(=O)NR^6R^7, and

R^5 is C_1-C_4-alkyl,

R^6 and R^7 are independently of one another hydrogen, phenyl, C_1-C_4-alkyl, or

together with the nitrogen atom to which they are bonded form a 5- to 6-membered heterocyclyl,

R^2 is hydrogen, C_1-C_4-alkyl, trifluoromethyl, C_1-C_4-alkoxy,

or

R^1 and R^2 together with the carbon atom to which they are bonded form C_5-C_6-cycloalkyl, C_5-C_6-cycloalkenyl or 5- to 6-membered heterocyclyl, which are optionally substituted by up to 2 substituents from the group of C_1-C_4-alkyl, C_1-C_4-alkoxy, hydroxy, oxo, -C(=O)OR^8, and

R^8 is C_1-C_4-alkyl or benzyl,

R^3 is hydrogen,

R^4 is pentan-3-yl, C_5-C_6-cycloalkyl,

X is oxygen or sulfur,

and the salts, solvates and/or solvates of the salts thereof.

4. A compound as claimed in claims 1 to 3, where

R^1 is methyl, ethyl, isopropyl, trifluoromethyl, methoxycarbonyl, ethoxycarbonyl or -C(=O)NR^6R^7, where methyl is optionally substituted by methoxycarbonyl or ethoxycarbonyl, and

R^6 is phenyl and

R^7 is hydrogen,

R^2 is hydrogen, methyl, trifluoromethyl, or

R^1 and R^2 together with the carbon atom to which they are bonded form cyclopentyl, cyclohexyl, cyclopentenyl or tetrahydrofuryl, where cyclohexyl is optionally substituted by methyl, and

R^3 is hydrogen,

R^4 is pentan-3-yl, C_5-C_6-cycloalkyl,

X is oxygen or sulfur,

and the salts, solvates and/or solvates of the salts thereof.

5. A compound as claimed in claims 1 to 4, where

R^1 is methyl, ethyl, isopropyl, methoxycarbonyl, ethoxycarbonyl or $-C(=O)NR^6R^7$, where methyl is optionally substituted by methoxycarbonyl or ethoxycarbonyl, and

R^6 is phenyl and

R^7 is hydrogen,

R^2 is hydrogen, methyl, or

R^1 and R^2 together with the carbon atom to which they are bonded form cyclopentyl, cyclohexyl, cyclopentenyl or tetrahydrofuryl, where cyclohexyl is optionally substituted by methyl, and

R^3 is hydrogen,

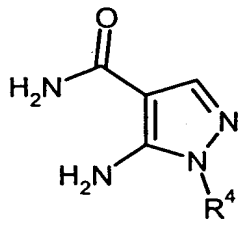
R^4 is pentan-3-yl, C_5-C_6-cycloalkyl,

X is oxygen,

and the salts, solvates and/or solvates of the salts thereof.

6. A process for preparing compounds as claimed in claims 1 to 5, characterized in that

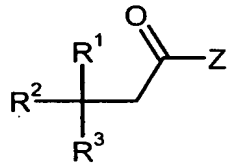
[A] compounds of the formula



(II),

in which R^4 has the meanings indicated above,

are converted by reaction with a compound of the formula



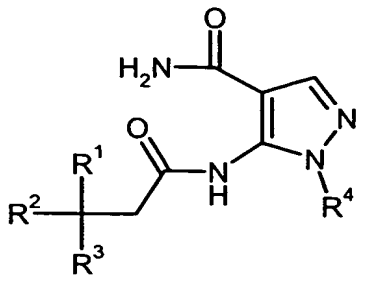
(IIIa),

in which R^1, R^2 and R^3 have the meanings indicated above,

and

Z is chlorine or bromine,

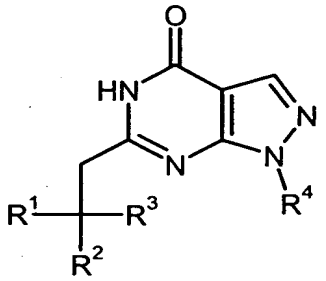
in an inert solvent and in the presence of a base initially into compounds of the formula



(IV),

in which R^1, R^2, R^3 and R^4 have the meanings indicated above,

then cyclized in an inert solvent and in the presence of a base to compounds of the formula

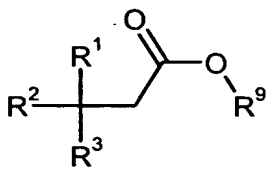


(IA),

in which R^1, R^2, R^3 and R^4 have the meanings indicated above,

or

[B] compounds of the formula (II) are reacted, with direct cyclization to (IA), with a compound of the formula



(IIIb),

in which R^1, R^2 and R^3 have the meanings indicated above

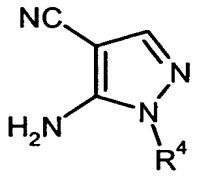
and

R^9 is methyl or ethyl,

in an inert solvent and in the presence of a base,

or

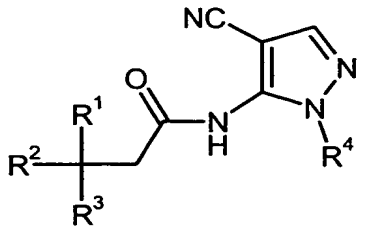
[C] compounds of the formula



(V),

in which R^4 has the meanings indicated above,

are initially converted by reaction with a compound of the formula (IIIa) in an inert solvent and in the presence of a base into compounds of the formula

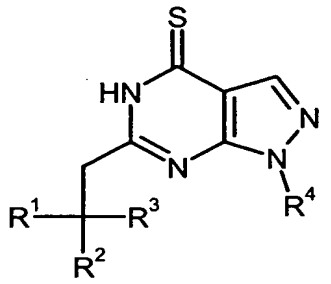


(VI),

in which R^1, R^2, R^3 and R^4 have the meanings indicated above,

and the latter are cyclized in a second step in an inert solvent and in the presence of a base and of an oxidizing agent to (IA),

and the compounds of the formula (IA) are where appropriate then converted by reaction with a sulfurizing agent such as, for example, diphosphorus pentasulfide into the thiono derivatives of the formula



(IB),

in which R^1, R^2, R^3 and R^4 have the meanings indicated above,

and the resulting compounds of the formula (I) are reacted where appropriate with the appropriate (i) solvents and/or (ii) bases or acids to give the solvates, salts and/or solvates of the salts thereof.

7. A compound as claimed in any of claims 1 to 5 for the treatment and/or prophylaxis of diseases.

8. A medicament comprising at least one of the compounds as claimed in any of claims 1 to 5 and at least one pharmaceutically acceptable, essentially nontoxic carrier or excipients.

9. The use of the compounds as claimed in any of claims 1 to 5 for producing a medicament for the prophylaxis and/or treatment of impairments of perception, concentration, learning and/or memory.

10. The use as claimed in claim 9, where the impairment is a consequence of Alzheimer's disease.

11. The use of the compounds as claimed in any of claims 1 to 5 for producing a medicament for improving perception, concentration, learning and/or memory.

12. A method for controlling impairment of perception, concentration, learning and/or memory in humans or animals through administration of an effective amount of the compounds from claims 1 to 5.

13. The method as claimed in claim 12, where the impairment is a consequence of Alzheimer's disease.